

# Pre-service Teachers' Perception of Their Mathematics Classroom Environment in Ghanaian Colleges of Education

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Received August 28, 2020; Revised September 30, 2020; Accepted October 11, 2020

**Abstract** Classroom learning environment is one of the prominent areas of research in STEM education over the last three decades. The purpose of this study was to investigate pre-service educators' perception of their mathematics classroom environment in Colleges of Education in the Central Region of Ghana. In all, 186 pre-service mathematics teachers were randomly selected by census to take part in the study. The cross-sectional survey design was adopted. Data were analysed using means, independent samples t-test and one way between group ANOVA. The outcomes indicated that pre-service mathematics teachers have a high level of perception on their classroom environment. It was additionally discovered that there was no factually noteworthy contrast in the view of pre-service mathematics instructors on their classroom condition among male and female in the Colleges of Education. Finally, there was no measurably critical contrast in view of pre-service mathematics educators across the three Colleges of Education. It was recommended that Colleges of Education should maintain the high level of the mathematics classroom atmosphere as being experienced by the three colleges used for this study. It was suggested that the study should be done on a large scale to cover all Colleges of Education in Ghana.

**Keywords:** colleges of education, mathematics classroom environment, perceptions, pre-service mathematics teachers

**Cite This Article:** Samuel Crankson, Kofi Dwumfuo Agyeman, and Millicent Narh-Kert, "Pre-service Teachers' Perception of Their Mathematics Classroom Environment in Ghanaian Colleges of Education." *American Journal of Educational Research*, vol. 8, no. 10 (2020): 739-745. doi: 10.12691/education-8-10-1.

## 1. Introduction

The learning environment in education has a enormous impact on what learners learn or accomplish. It is view of this that Ryan [1], indicated that learners spend most of their time in a learning atmosphere like the classroom as this is the place where they will gain proficiency with the different abilities regarded fundamental and appropriate for them to make progress in the worldwide society. Ryan has opined that the learning environment is the place where learners are trained to have knowledge and aptitudes to reach their full potential and develop a better future for them. Ryan indicated that it is beneficial to comprehend the ways in which learning environment impacts achievement in order to make the most of efficiency in instruction as it is an essential place in the scholastic development of learners. Different investigators have additionally given a vivid picture of the classroom environment. For example, Bates [2] has indicated that the learning environment alludes to the different physical

areas, settings, and cultures in which learners learn. Bates additionally showed that the term explains the culture of a school or class, its overriding principle and qualities, as well as how people cooperate with and treat each other just as the manners by which educators may arrange an instructive setting to encourage learning. Consequently, Stewart, Evans and Kaczynski (as cited in [3]), showed that the learning setting cannot be secluded as one explicit element, as the entire classroom setting of the learning platform comprises of some factors, for example, physical learning space, social learning space (educator viability, controlling of behaviour and managing instructional time), and the mental/emotional/psychosocial learning atmosphere. Turano further opined that learners of all ages and grade level benefit from the factors that contribute to learning environment, which have climates that could assume a genuine function in the achievement of the learners.

The classroom learning atmosphere impacts learner results and assumes a significant function in ameliorating the productivity and degrees of commitment in the classroom (Arisoy [4]; DiTullio [5]; Yu-Liang [6]). Arisoy additionally indicted that the tangible atmosphere

(precisely the physical arrangement of the classroom, for example, furniture, lighting, spaces, work areas, and seats), influences the security and solaces of learners, just as their individual learning advancement (Atbas [7]). Investigation on the introduction of learners to different instructive materials recorded some advantages to learners. These advantages include making learning simpler, supporting dynamic and individual learning, giving genuine life encounters, improving problem solving skills, critical thinking, and inventive reasoning abilities (Apperson, Laws, & Scepansky [8]).

Greater ideals for learner accomplishment have driven numerous schools to present investigated environment solutions that positively influences student achievement (U.S. Department of Education [9]). Each learner possesses remarkable differences and learning styles, consequently their classroom encounters must be considered significant, or scholarly achievement could be adversely influenced (Baeten, Dochy, & Struyven [10]; Colak, [11]). Learners who participate in classroom activities are bound to be viewed as fulfilled, as they are less inclined to drop out, and bound to accomplish higher outcomes, and take part in positive discourse with the establishment after graduation (Alves & Raposo, [12]).

## 2. Literature

Investigation greatly demonstrates that school atmosphere theories incline to have robust parallels with classroom equivalents (Wang & Holcombe, [13]). Accordingly, Gentilucci and Gentilucci [14] investigated learners' perception of the school and classroom atmosphere, and how experiences in the school and classroom impact their learning, using an inductive approach to collect and analyse data. The study comprised collecting data for more than 34 years from middle school students in three different cohorts in 1979, 2000, and 2013. Information gathered from the last two groups were evaluated to decide whether, how, and why learners' view of school and classroom learning altered after some time. Results inferred that learners in each group identified school' and instructor' attributes, instructional practices, homeroom discipline, and the degree of challenge in the educational programme as the factors generally answerable for advancing learner learning.

In another research, Afari, Aldridge, Fraser, and Khine [15] explored whether the presentation of games into school level arithmetic classes in the United Arab Emirates (UAE) was powerful regarding improving learners' impression of the learning condition and their perspectives towards mathematics. For an example the investigation used 33 classes comprising 352 learners, of which eight of the classes made up of 90 learners were presented with mathematics games. Learners who participated in the mathematics games perceived statistically significantly more educator assistance, participation, individual importance, satisfaction of mathematics lessons and academic efficacy as some of the influencers.

Similarly, Yang [16] conducted an investigation into "junior high learners' perceptions of mathematics classroom learning environments in China." The investigation uncovered that Chinese junior high learners generally had negative perception of their mathematics classroom environments. Specifically, Grade 9 learners were found to perceive their mathematics classroom learning environments negatively than Grade 7 and Grade 8 learners did. Besides, young men were found to view their mathematics classes as more request situated and see themselves as moderately more scientifically included, while young ladies saw more open doors for participation and recognized what was expected to contend in science classes. Besides, young men were found to view their mathematics classes as more inquiry-based and view themselves as moderately more mathematically involved, while girls viewed more chances for participation and recognized what was expected to contend in mathematics classes.

In a related research, Yang [17] explored how senior high school learners in China viewed their mathematics classroom atmospheres and the connection between their observations and perspectives towards mathematics. The outcomes uncovered that these senior high learners usually did not view their mathematics classroom atmospheres very positively. Learners' views of their classroom learning atmospheres were found regarding gender and grade differences.

Similarly, Guo [18] conducted a research Chinese junior middle school learners' view of science homeroom learning atmospheres and ways to deal with learning mathematics. The findings of this investigation show that Chinese learners failed to view their classroom learning environment as generally positive, and would in general utilise profound learning approach and surface thought process in mathematics learning. The results indicate that deep methodologies were positively correlated with Chinese learners' views of mathematics classroom learning environments.

Again, Tshewang, Chandra and Yeh [19] conducted a "study of learners' and educators' opinions of their classroom learning atmosphere in Bhutanese eighth-grade mathematics classes." The findings indicated that learners and educators mostly perceived their classroom atmospheres positively on the Mathematics Classroom Learning Environment Survey (MCLES) scales regardless of sexual orientation, school level and school location.

## 3. Theoretical Framework

### 3.1. The What Is Happening in This Class (WIHIC) Questionnaire

The WIHIC quantifies secondary school learners' view of their homeroom atmosphere [19] and a wide scope of measurements that are essential to the current circumstance classrooms. The WIHIC incorporates important measurements from past questionnaires and joins these with dimensions that measure specific features of constructivism and other pertinent components working in modern homerooms.

**Table 1. Scale Description for each Scale and Example of Items in the What Is Happening in This Class? (WIHIC) Questionnaire**

Scale	Description	Item	Moos' Dimension
Student Cohesiveness	Extent to which students know, help and are supportive of one another.	I make friendship among students in this class.	Relationship
Teacher support	Extent to which teacher helps, befriends, trusts, and shows interest in students.	The teacher takes a personal interest in me.	Relationship
Involvement	Extent to which students have attentive interest, participate in discussions, perform additional work and enjoy the class.	I discuss ideas in class	Relationship
Investigation	Extent to which there is emphasis on the skills and their use in problem-solving investigation	I am asked to think about the evidence for statements.	Personal growth
Task Orientation	Extent to which it is important to complete activities planned and to stay on the subject matter.	Getting a certain amount of work done is important.	Personal growth
Cooperation	Extent to which students cooperate rather than compete with one another on learning tasks.	I cooperate with other students when doing assignment work.	Personal growth
Equity	Extent to which the teacher treats students equally.	The teacher gives as much attention to my questions as to other students' questions.	System maintenance and change.

“A description of each scale in the WIHIC is presented in Table 1. Moos' [20] conceptual framework for human environments that characterises atmospheres as having relationship, personal growth, and system maintenance and change dimensions have also been included in Table 1. According to Dorman [21], Moos explained that relationship dimensions are concerned with the nature and intensity of personal relationships, personal growth dimensions focus on opportunities for personal development and self-enhancement. System maintenance and system change dimensions assess the extent to which the environment is orderly, clear in expectations, maintains control, and is responsive to change.

The original version of the WIHIC contained 90 items and nine scales but was refined by both statistical analysis and extensive interviewing of students to the current 40 items and 8 scales (Fraser, McRobbie, & Fisher [22]; Huang & Fraser, [23]). The WIHIC has been reported as useful and valid across a number of countries and subjects” (Den Brok, Fisher, Rickards, & Bull, [24], pp. 7-8).

Den Brok et al. ([24], p. 9) observed that “Dorman [21] detailed that the reliability of the scales (Cronbach's alpha) of the WIHIC tool is usually above .70 at the student level and above .85 at the class level. Exploratory and confirmatory factor analysis shows that the items of the WIHIC typically have factor loadings above .40 on their a priori scales and lower loadings on other scales. Average correlations between the scales of the WIHIC, a convenient measure of discriminate validity, have also been reported between approximately .20 and .50, indicating that each of the seven scales measures distinct, though partly overlapping, elements of the classroom environment”.

### 3.2. Statement of the Problem

A review of related literature has indicated that investigators have mainly focused on assessing junior high and senior high school students' [16,17,18] and in-service teachers' [19] perceptions of their mathematics classroom environment. Similarly, the literature indicates that past studies in this field mostly focused on examining learners' opinions or educators' views of their classroom

atmospheres, but that few studies involved views of the learning atmosphere in mathematics classrooms [15]. Currently, there hasn't been much research on the opinions of classroom learning atmospheres in the Ghanaian school situation, especially the Colleges of Education (COEs) where a novel mathematics curriculum was recently introduced as a result of the establishment of a 4 year B.Ed. (Basic Education) in the COEs. Less attention has been paid to pre-service educators' perception of their mathematics classroom situation in Ghanaian colleges of education [15]. Yet when pre-service mathematics teachers trained at the colleges of education are employed in junior high schools, they teach mathematics to learners. The pre-service mathematics instructors used in this study are trained to teach mathematics at the junior high school level in Ghana. Consequently, the current study, aimed to investigate pre-service teachers' perception of their mathematics classroom environment in Ghanaian colleges of education.

### 3.3. The Purpose of the Study

The investigation aimed at exploring the following based on the problems discussed:

- i) Perception of pre-service educators' mathematics classroom atmosphere.
- ii) Difference in perception between male and female pre-service educators on their mathematics classroom atmosphere.
- iii) Difference in perception of pre-service teachers on their mathematics classroom atmosphere across colleges.

### 3.4. Research Questions

1. What is the level of perception of pre-service educators of their mathematics classroom environment?
2. What is the difference in perception between male and female pre-service educators on their mathematics classroom environment?
3. What is the difference in perception of pre-service educators on their mathematics classroom environment across colleges?

### 3.5. Significance of the Study

The investigation is important for various reasons. Findings of the investigation had delivered further data with respect to factors that impact the view of pre-service educators of their mathematics classroom environment. Guidance coordinators just as instructors in schools could utilise the suggestions to help learners in their studies. The result of the investigation would help educational policy formulators, implementers and curriculum developers to adopt suitable methodologies that will help enhance the achievement of learners in mathematics.

## 4. Research Methods

### 4.1. Research Design

Based on the purpose of this study, the cross-sectional survey design was adopted to investigate the perception of pre-service teachers on their mathematics classroom environment. This design was deemed appropriated because it allows researchers to collect a lot of information on pre-service mathematics educators' perception on their classroom environment from a large number of participants within a short period of time (Creswell, [25]).

### 4.2. Sampling Procedure

Pre-service mathematics educators in the three Colleges of Education in the Central region of Ghana formed the target population of this investigation. The accessible population was final year pre-services educators offering the mathematics programme in these colleges. The census sampling procedure was utilised in getting the sample for the research. This means all final year pre-service mathematics educators present at the time of data collection were selected for the study. In all, 186 pre-service mathematics educators took part in the study. The sample distribution of the three Colleges of Education is as follows: College A 50, College B 71 and College C 50 pre-service mathematics teachers.

### 4.3. Instrumentation

The data collection instrument for the study was a questionnaire called Pre-Service Mathematics Teachers Classroom Environment Questionnaire (PMTCEQ) adapted from an instrument originally developed by Fraser, Fisher and McRobbie [22] which they called "What Is Happening in this Class (WIHIC)" employed to measure high school learners' perception of their science classroom environment. Aspects of Fraser et al.'s instrument were reframed to suit the Ghanaian Colleges of Education context. The items on PMTCEQ used a five point Likert-scale with responses and ratings from 'Almost never (1)', 'Seldom (2)', 'Sometimes (3)', 'Often (4)' to 'Very often (5)' for positive statements. The instrument was validated by experts in classroom environment in the University of Cape Coast to check for content validity.

The instrument was pilot tested in one College of Education in the Western region of Ghana. This is because students from this region possess similar characteristics to

those in the area of the study. They have similar backgrounds in education, for example, as they all attended similar high schools across Ghana before being enrolled in the Education Colleges. Similarly, all the Colleges of Education follow the same mathematics curriculum and write the same exams as well. These commonalities prompted the use of that College of Education in the Western region for the pilot test. In all, fifty pre-service mathematics educators responded to the instrument and its reliability coefficient using Cronbach alpha was found to be .79.

### 4.4. Data Collection

The researchers wrote to the principals of the three Colleges of Education in the Central region where the study took place to seek permission and then visited the colleges to establish rapport with the pre-service mathematics educators and their Tutors. Data were collected by administering the instrument to pre-service mathematics educators on the second visit by the researchers from one college to another. Pre-service mathematics educators were assured of confidentiality and anonymity and told the results will be used only for academic purposes. It took an average of thirty-five minutes for the pre-service teachers to respond to the instrument.

## 5. Results and Discussion

In this, the researchers presented the results according to the research questions raised and discussed the findings in the light of literature on classroom environment.

### 5.1. Level of Perception of Pre-service Teachers on Their Mathematics Classroom Environment

The research question sought the perception of pre-service teachers on their mathematics classroom environment. For easy interpretation of the results in determining the level of pre-service teachers' perceptions, the five point Likert-scale responses were further categorised into three as follows: 1.0 - 2.4 as low perception level, 2.5 - 3.4 as moderate perception level and 3.5 - 5.0 as high perception level. To answer this research question, the 40 items were computed into a single mathematics classroom environment variable and the grand mean was used for interpretation based on the three categorisation stated above. The outcomes are presented in Table 2.

As shown in Table 2, pre-service mathematics teachers have a high perception of their classroom environment ( $M = 3.844$ ). This implies that pre-service mathematics teachers are much satisfied with their level and conditions of the classroom environment they used for their off-campus teaching practice and what they experience in their colleges. This finding supports the findings of Tshewang, Chandra and Yeh [19] who that students and teachers mostly perceived their classroom environments favourably on the Mathematics Classroom Learning Environment Survey (MCLES) scales irrespective of gender, school level and school location.

**Table 2. Descriptive statistics of the perception of pre-service teachers on their classroom environment**

N	Range	Minimum	Maximum	Sum	Mean	Std. Deviation	Variance
186	2.57	2.23	4.80	715.03	3.844	.480	.230

It seems these secondary school students may be enjoying similar mathematics learning environment as pre-service mathematics teachers used in this current study. The study of Murugan [26] also showed secondary school students had a moderate perception of their mathematics classroom environment. Such a conducive learning environment, as reported in literature, has the potential of improving students learning outcome since they will be motivated to learn [2].

However, it is surprising to note that elsewhere students do not perceive their mathematics classroom environment to be favourable. Typical amongst them is the study by Yang [16] who, though worked on junior secondary students' perceptions of mathematics classroom learning environment, found students perceptions of their mathematics classroom environment to be unfavourable. Similarly, Yang [17] in a study on how senior secondary school students in China perceived their mathematics classroom environments, found that these students generally did not perceive their mathematics classroom environments very favourably. From the foregoing, it is clear that when students learn under such unfavourable conditions, productivity will be low and learning will not be achieved [3]. Even though, this study was conducted on pre-service mathematics teachers, Turano [3] contends that the factors that contribute to learning environment are relevant to students of all ages and grade levels to promote the success of students.

## 5.2. Difference in Perception between Male and Female Pre-service Teachers on Their Mathematics Classroom Environment

This research question sought to determine whether there is a statistically significant difference in the perception of pre-service male and female teachers on their mathematics classroom environment. To achieve this, the independent samples t-test was used to compare their perceptions. The independent variable in this research question is sex at two levels (i.e., male and female) and the dependent variable is perception of pre-service teachers' mathematics classroom environment. As shown in Table 3, there was no statistically significant difference in perception of pre-service teachers on their mathematics classroom environment between male [ $M = 3.810$ ,  $SD = .404$ ] and female [ $M = 3.869$ ,  $SD = .529$ ,  $t(184) = .846$ ,  $p < .339$ ] pre-service teachers. This means both male and female pre-service mathematics teachers enjoy the same favourable classroom environment during their interactions.

**Table 3. Results of independent sample t-test on the perception of pre-service mathematics teachers on classroom environment across sex**

Sex	N	Mean	SD	t	df	p-value
Control	77	3.810	.404	.846	184	.399
Experimental	109	3.869	.529			

This finding supports the results of Murugan [26] who found no statistically significant difference in perception of mathematics learning environment based on sex. This suggests that sex difference has no effect on students' perception of their mathematics classroom environment. This assertion makes a lot of sense since both male and female students learn under the same condition and also taught by the same teachers. On the other hand, findings of a number of studies contradict this current finding. For instance, Yang [17] found that there was a statistically significant difference in perception of mathematics classroom learning environment between male and female secondary school students. This study failed to show where the differences were. However, Yang [16] showed that there was a significant difference in perception of male and female junior high school students with respect to their mathematics classroom environment. Yang found boys to perceive their mathematics classes as more inquiry-oriented while girls perceived more opportunities for cooperation.

## 5.3. Difference in Perception of Pre-service Teachers on Their Mathematics Classroom Environment across the Colleges

Research question three sought to compare the perception of pre-service teachers on their mathematics classroom environment across the three colleges in the Central region. This comparison was deemed necessary because, there is likelihood that each college may have a unique mathematics classroom environment that could bring a difference. The comparison was done using one-way analysis of variance (ANOVA) since the independent variable is college-type at three levels and the dependent variable is perception of pre-service teachers' mathematics classroom environment. Assumption testing for normal distribution of scores, homogeneity of variances, largeness of sample size, random sampling and independence of observation were done and no violations were detected.

The descriptive statistics, specifically the means and standard deviations, are presented in Table 4. As shown in Table 4, the means and standard deviations look similar and so need to be tested to see whether there exist statistically significant differences in the mean scores.

As shown in Table 5, the ANOVA results presented no statistically significant difference in perception of pre-service teachers on their mathematics classroom environment among the three colleges. This suggests that pre-service mathematics teachers learn and teach under similar classroom environment.

**Table 4. Descriptive statistics of perception of pre-service mathematics teachers**

School	N	Mean	Standard Deviation
A	65	3.863	.458
B	71	3.844	.415
C	50	3.821	.590
Total	186	3.844	.480

**Table 5. ANOVA results of the perception of pre-service mathematics classroom environment**

	Sum of Squares	df	Mean Square	F	p
Between Groups	.049	2	.025	.106	.900
Within Groups	42.552	183	.233		
Total	42.601	185			

One would have thought that there should be a difference in pre-service teachers' perception of their mathematics classroom environment among the three colleges of education used for this study. This is because they are in different locations, enjoying different conditions and being taught by different tutors. Such different conditions should have led to a difference in perception but the contrary was found. The finding of no difference in perception could be due to the fact that the colleges made provision for conducive physical, social, and psychological mathematics classroom learning environment for pre-service teachers to enjoy similar conditions [3]. This possibly could have led the pre-service mathematics teachers to exhibit similar perceptions.

## 6. Conclusions

Based on the findings of this study, it was concluded that pre-service mathematics teachers have a high level of perception on their classroom environment. Again, there was no statistically significant difference in the perception of pre-service mathematics teachers on their classroom environment between male and female in the Colleges of Education. Finally, there was no statistically significant difference in perception of pre-service mathematics teachers across the three Colleges of Education.

## 7. Recommendations and Implications

It was recommended that Colleges of Education should maintain the high level of the mathematics classroom environment as being experienced by the three colleges used for this study. This has the potential of improving the performance pre-service mathematics teachers and subsequently having a direct effect on the students they will teach. Further, male and female pre-service teachers should continue to enjoy the same classroom environment since they will all graduate and teach similar levels of students in our schools. Finally, all Colleges of Education should provide similar mathematics classroom environment in order to booth same level of teaching.

## 8. Suggestion for Further Studies

The limitation of this study was that only pre-service mathematics teachers in the three Colleges of Education in the Central region participated in the study. It is, therefore, suggested that the study should be done on a large scale to cover all Colleges of Education in Ghana and also be done in other subject areas.

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